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TO: Examiner: Dung A. Lee  
YOUR FAX NO.: 703-872-9306  
FROM: Kenton R. Mullins  
RE: U.S. Application No. 10/609,039  
Applicant: Pei-Hung Chu

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# DRAFT

1. (Currently Amended) A method of forming a contact hole with a spacer, comprising the steps of:
  - (a) providing a substrate suitable for fabrication of integrated circuits and covered by at least a first dielectric layer, an etch stop layer and a patterned photoresist mask layer;
  - (b) etching the etch stop layer and the first dielectric layer using the patterned photoresist mask layer as a mask to form a contact hole exposing the substrate;
  - (c) forming a conformal second dielectric layer on the etch stop layer and in the contact hole; and
  - (d) anisotropically etching the second dielectric layer to form a spacer on the sidewall of the contact hole.
2. The method of claim 1, wherein the etch stop layer comprises a dielectric antireflective coating layer.
3. (Currently Amended) The method of claim 1, wherein the conformal second dielectric layer is etched at a greater rate than the etch stop layer in step (d).
4. (Currently Amended) The method of claim 1, wherein the conformal second dielectric layer is etched 20 or more times as fast as the etch stop layer in step (d).
5. (Currently Amended) The method of claim 1, wherein the etch stop layer adjacent to the contact hole is not removed in step (d).
6. (Currently Amended) The method of claim 2, wherein step (d) uses an etching gas comprising oxygen, fluorocarbon gas and carbon oxide.
7. (Currently Amended) The method of claim 6, wherein:
  - the first and the second dielectric layers are silicon oxide layers;
  - the flow rates in step (d) of the oxygen, fluorocarbon gas and carbon oxide are about 140 sccm, between about 4 and 6 sccm, and between about 50 and 100 sccm.
8. The method of claim 6, wherein the second dielectric layer is a tetraethylorthosilicate oxide layer.
9. The method of claim 7, wherein the antireflection coating layer is a silicon oxynitride layer.
10. (Currently Amended) The method of claim 7, wherein:
  - a pressure within an etch chamber is about 90 mTorr during step (d);
  - the power within an etch chamber is 200 W for a low frequency and 800 W for a high frequency during step (d); and
  - the etching gas further comprises argon with a flow rate of about 140 sccm acting as a carrier gas.
11. (Currently Amended) A method for creating contact holes having a uniform diameter from top to bottom, comprising the steps of:

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- (a) forming a dielectric layer over a bottom layer;
- (b) forming an ~~etch-stop~~ a material layer over the dielectric layer;
- (c) forming a patterned photoresist mask layer above the ~~etch-stop~~ material layer;
- (d) etching contact holes into the dielectric layer and the ~~etch-stop~~ material layer using the patterned photoresist mask layer as a template to expose a surface of the bottom layer;
- ~~(e) removing the patterned photoresist layer;~~
- ~~(fe)~~ forming a spacer material layer over the ~~etch-stop~~ material layer and into the contact holes; and
- ~~(gf)~~ removing the spacer material layer ~~from over the~~ using the material layer as an etch stop layer, wherein portions of the spacer material ~~remains~~ layer remain in the contact holes.

12. (Currently Amended) The method of claim 11, wherein the ~~etch-stop~~ material layer comprises a dielectric antireflective coating layer.

13. (Currently Amended) The method of claim 11, wherein the spacer material layer is etched 20 or more times as fast as the stop etch layer in step ~~(gf)~~.

14. (Currently Amended) The method of claim 11, wherein the ~~etch-stop~~ material layer adjacent to the contact hole is not removed in step ~~(gf)~~.

15. (Currently Amended) The method of claim 12, wherein the ~~step of removing of~~ the spacer material layer further comprises anisotropically etching the spacer material layer in an etch chamber using an etching gas comprising oxygen, fluorocarbon gas and carbon oxide.

16. (Currently Amended) The method of claim 15, wherein:  
a flow rate of the fluorocarbon gas is between about 4 and 6 sccm; and  
the dielectric layer and the spacer material layer comprise silicon oxide.

17. The method of claim 15, wherein the dielectric antireflective coating layer is a tetraethylorthosilicate oxide layer.

18. The method of claim 15, wherein the dielectric antireflection coating layer is a silicon oxynitride layer.

19. (Currently Amended) The method of claim 15, wherein:  
a pressure within the etch chamber is about 90 mTorr during step ~~(gf)~~;  
the power within the etch chamber is 200 W for a low frequency and 800 W for a high frequency during step ~~(gf)~~; and  
the etching process during step ~~(gf)~~ is performed for between about 20 and 30 seconds.

20. (Currently Amended) The method of claim ~~20~~15, wherein:

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the etching gas further comprises argon with a flow rate of about 140 sccm acting as a carrier gas;  
the flow rate of the oxygen is about 140 sccm;  
the flow rate of the carbon oxide is between about 50 and 100 sccm;  
the thickness of the antireflective coating layer is between about 200 and 400 angstroms.

21. (Currently Amended) A method of forming a contact hole with a spacer, comprising the steps of:

- (a) providing a substrate suitable for fabrication of integrated circuits and covered by a first dielectric layer and an etch stop layer;
- (b) etching the etch stop layer and the first dielectric layer to form a contact hole exposing the substrate;
- (c) forming a conformal second dielectric layer on the etch stop layer and in the contact hole; and
- (d) etching the second dielectric layer to form a spacer on the sidewall of the contact hole, wherein etching of the second dielectric layer occurs at a faster rate than etching of the etch stop layer.

22. (Currently Amended) The method of claim 21, wherein the second dielectric layer is etched 20 or more times as fast as the etch stop layer in step (d).

23. (Currently Amended) The method of claim 21, wherein the etch stop layer adjacent to the contact hole is not removed in step (d).

24. The method of claim 23, wherein the etch stop layer comprises a dielectric antireflective coating layer.

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